Topic: Continuously compounded interest

Question: How much do you owe today?

Four years ago, you owed $\$10$ on your credit card. Since then, you have not made any payments. The card carries an annual interest rate of $22\,\%$, compounded continuously. How much do you owe on your credit card today?

Answer choices:

A $\$21.14$

B $\$24.11$

C $\$21.41$

D $\$14.11$

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Solution: B

We can use the exponential growth equation

$$A(t) = A_0 e^{rt}$$

where $A(t)$ is the final amount after time t, A_0 is the initial amount, and r is the interest rate.

Remember to make sure that interest rate and time are in the same units (if your interest rate is annual, time should be in years).

$$A(t) = 10e^{(0.22)(4)}$$

$$A(t) = 24.11$$

You owe $\$24.11$ on your credit card.

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Topic: Continuously compounded interest

Question: How many years have you had the investment?

Your investment bond is currently worth $\$5{,}632$. You made an initial investment of $\$1{,}000$ at an annual interest rate of $4.5\,\%$ compounded continuously. How many years have you had your investment?

Answer choices:

A 384 years

B $3{,}840$ years

C 38.4 years

D 3.84 years

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Solution: C

We can use the exponential growth equation

$$A(t) = A_0 e^{rt}$$

where $A(t)$ is the final amount after time t, A_0 is the initial amount, and r is the interest rate.

Remember to make sure that interest rate and time are in the same units (if your interest rate is annual, time should be in years).

$$5{,}632 = 1{,}000e^{(0.045)t}$$

$$\frac{5{,}632}{1{,}000} = e^{(0.045)t}$$

$$5.632 = e^{(0.045)t}$$

$$\ln 5.632 = \ln\left(e^{(0.045)t}\right)$$

$$\ln 5.632 = (0.045)t$$

$$t = \frac{\ln 5.632}{0.045}$$

$$t = 38.4$$

You've had your investment for 38.4 years.

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Topic: Continuously compounded interest

Question: What was the interest rate?

Twenty years ago, you purchased $\$5{,}000$ worth of stock market shares. These special shares paid a continuously compounded, annual interest rate. Today your shares are worth $\$45{,}000$. What was the interest rate?

Answer choices:

A $111\,\%$

B $0.11\,\%$

C $1.1\,\%$

D $11\,\%$

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Solution: D

We can use the exponential growth equation

$$A(t) = A_0 e^{rt}$$

where $A(t)$ is the final amount after time t, A_0 is the initial amount, and r is the interest rate.

Remember to make sure that interest rate and time are in the same units (if your interest rate is annual, time should be in years).

$$45{,}000 = 5{,}000e^{r(20)}$$

$$\frac{45{,}000}{5{,}000} = e^{r(20)}$$

$$9 = e^{r(20)}$$

$$\ln 9 = \ln\left(e^{r(20)}\right)$$

$$\ln 9 = r(20)$$

$$r = \frac{\ln 9}{20}$$

$$r = 0.11$$

The interest rate of the shares was $11\,\%$.

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